# INTERNAL AUDIT
# SUBSTANTIVE TESTING
# DATA MINING

August 16, 2004

Roanoke City Council Audit Committee
Roanoke, Virginia

We have completed a data mining audit of expenditures. We performed this audit in accordance with generally accepted government auditing standards.

## BACKGROUND

Data mining is the search for relationships that can exist in large databases, but are hidden among vast amounts of data. Computer technology provides auditors with the means to examine large databases using various criteria to identify trends, unusual relationships, and higher risk transactions. This allows the auditor to focus his or her work on those transactions that are more likely to involve errors or irregularities. Once the transactions are identified, the supporting documents are reviewed and personnel involved are interviewed to provide a basis for evaluating the propriety of the transactions. Our office performs this type of analysis throughout the fiscal year, as time allows, and reports the results in one comprehensive final report.

## SCOPE & OBJECTIVES

We conducted two data mining projects in the fiscal year ended June 30, 2004, as described below:

- In September of 2003, we designed an analysis to identify unusual trends in purchases using the City's purchasing cards. We evaluated all purchases made with the City's cards between August 19, 2002 and March 30, 2003.

- In March of 2004, we designed an analysis to determine if departments split purchases in order to keep expenditures below the threshold requiring the use of centralized purchase orders and formal involvement by the City's Purchasing department.

## METHODOLOGY

We utilized Audit Command Language software (ACL) to design an analysis of purchasing card transactions using Benford's law. The basis of Benford's law is that leading digits in any number set occur in a predictable pattern. As an illustration, the Benford algorithm might predict that 5% of our purchases should have the leading digits "14" in the amount (ex. $142.00). By sorting our purchase amounts according to leading digits and overlaying the Benford algorithm, we can identify anomalous purchasing patterns. Once we identified spikes in the occurrence of certain sets of leading digits, we pulled a sample of the purchases involved and evaluated the documentation supporting the expenditures.

In our analysis of decentralized purchase orders, we downloaded all purchases from the AMS advantage system into a Microsoft Access database. We then used Access to filter out all purchases except decentralized purchase orders (PDQs). We then sorted PDQs by vendor name and date in order to focus on payments to vendors that were clustered close together. In those instances where we noted clusters of payments, we pulled a sample of checks and reviewed the supporting documentation. Depending on the information gleaned from the invoices, we either cleared the issue or performed additional procedures. Additional procedures included interviewing employees and managers, researching and contacting vendors, and reviewing the information with the City's Purchasing Manager to obtain her evaluation of the purchases. We also consulted with the Department of Technology to evaluate purchases related to information technology.

## RESULTS

Our analysis of purchases using the City's purchasing card data did not identify any erroneous or irregular purchases. Our purchase card test work focused on the purchases with the leading digits of 24, 89, 99, as they appeared to be occurring at significantly higher rates than projected by the Benford algorithm. Upon review of the documents and interviews with managers, we were able to determine the basis of these anomalies and were satisfied that the expenditures reported were accurate and reasonable.

Our analysis of PDQs did not identify any purchases that were intentionally split in order to avoid involving the Purchasing department. We did identify isolated cases when work could have been bid as one job had the work been better planned. We also identified other minor compliance matters that were communicated to individual managers by letter.

## CONCLUSION

Based on the results of our audit work, we conclude that there were no material irregularities in the City's purchasing card transactions for the period reviewed. Also, we conclude that there were no clear, intentional attempts to split purchases over the period reviewed.

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